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A LECTURE

ON

INJURIOUS INSECTS,

DELIVERED AT THE

Royal Agricultural College, Cirencester.

BY

ELEANOR Anne ORMEROD, F.M.S., &c., 1828-1901

AUTHOR OF 'REPORTS ON INJURIOUS INSECTS,' 'MANUAL OF INJURIOUS INSECTS, 'COBHAM JOURNALS,' ETC.

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INJURIOUS INSECTS.

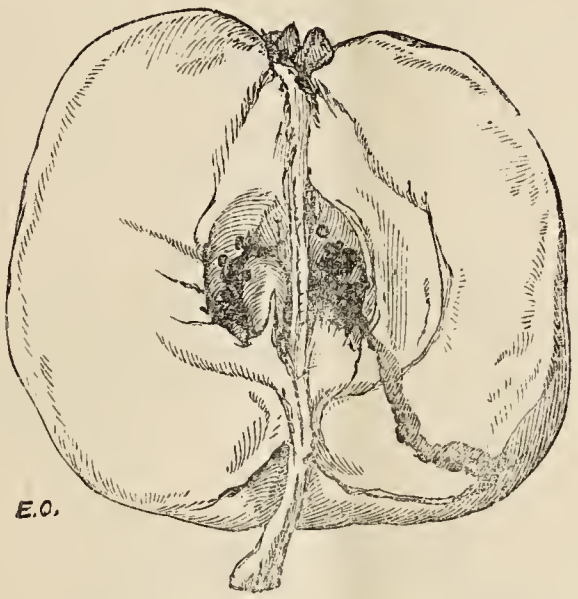
The following lecture was delivered before the students of the Royal Agricultural College on Thursday, October 20th, 1881, by Miss Ormerod, author of the 'Manual of Injurious Insects,' &c., on Insects injurious to Farm Crops, and their treatment. In addition to the Principal, the Professors, and a full attendance of students, there were present the Right Honourable Earl Bathurst, Mr. H. J. Elwes, Mr. Christopher Bowly, and several ladies.

At the very outset of attention to Economic Entomology, or, in plain words, study of the habits of insects that are injurious or beneficial to us, it would clear away many of the difficulties which dishearten observers if they would but rightly consider what it is that they need to know, and also how much of this they are already in some degree acquainted with. Unfortunately the general idea of what is needed is, that we should be able to take up an insect, *any insect* that we may chance to meet with, and name it; but this is very far from being the case. What we need is knowledge of the appearance and of the habits of the insect-pests throughout their lives, but we do not need it with regard to many kinds.

There are, speaking generally, only about a hundred kinds that are commonly injurious to a serious extent in this country to our food-crops, forest-trees, and hardy fruit. If we take the fruit grown under glass so as to include the important consideration of the Phylloxera of the vine, and also exceptional attacks, probably about a

hundred and fifty would include all that we need practically to study, and to us agricultural entomologists these attacks are shown by the state of the attacked crop. This point is of the utmost importance, and I earnestly wish that each observer would well consider it, for the feeling so often brought forward of not being able to follow up prevention of insect-attack from want of knowledge of Entomology, is doing infinite harm throughout the country. Our course is not to pick up a few insects, and by wearisome research find whether they do us any harm, but the reverse. We find the harm being done, and thus we are led directly to the causer of the mischief. In this room, at this present moment, there is at least one person who, if the many different kinds of Turnip Flea Beetle, commonly known as Fly, were handed round, would have some doubts as to accurately and with perfect conviction giving each its scientific specific name and synonym ; but probably there is no one among us who would not know "fly" attack in the Turnip field, and this is all that is needed to start with. And it is just the same with many of our crop attacks. Take the Corn. We know from the appearance of the wheat-ear where the Wheat Midge has been doing its destructive work; the so-called "gout" of the swollen Barley stem with the blackened channel running from the ear, still in its sheath, down the first joint of the stem, shows the presence of the Ribbon-footed Corn Fly, the *Chlorops tæniopus*. In our garden crops the presence of the Onion or of the Carrot Maggot are pointed out by the nature of the injuries they cause. With fruit, to give just one more instance, we know, or easily can know, by reference to accounts of enemies of the Apple, that the fruit which has fallen prematurely because a maggot has eaten round its central core, is injured by means of the Codlin Moth, although in this case it is such a regular part of the economy of the grub or caterpillar to make its way out on the falling of the Apple that we rarely see the cause of the fall. We know in these, and in many other instances, by the work done, what has

done it, and thus are trustworthily led on our search for the cause. We work on a solid and secure basis, without losing time, and our subject lies in our hand; but it

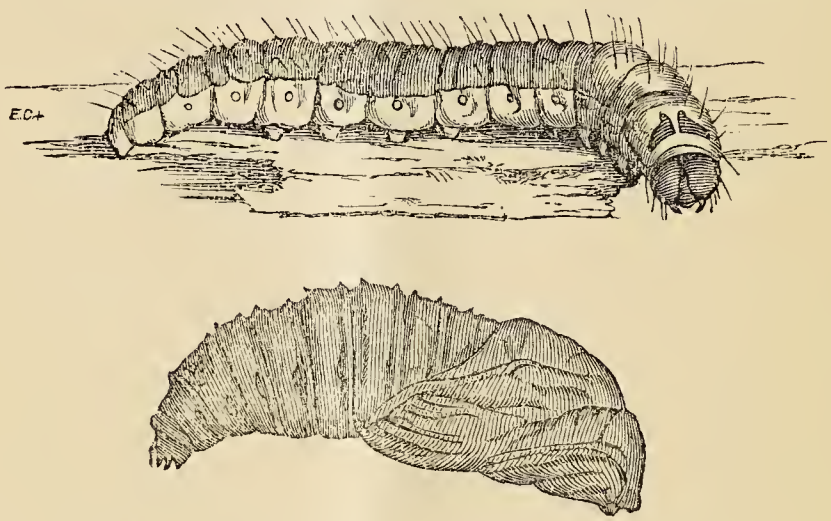


Apple injured by caterpillar of Codlin Moth.

is worse than useless, it is disheartening and confusing, to begin by endeavouring to take up what is not true entomology, what is not the knowledge of insects, but only the knowledge of their scientific names. We may turn, with the help of the index, to the accounts of the attacks that are given in the farm insects of John Curtis, and in our leading journals on farm, or garden, or forest management, or other works, and, guided by the description of the injury, may commonly be led on to the insect causer, and, if further help is needed, let us apply in each special case to those who devote their time to the study to give us the exact name of the insect; here there is no difficulty on that head. The thing that we need is the power of knowing 1st,—whether the creature under examination *is* an insect in some one or other of the three stages of its existence; and, 2ndly, to be able to tell generally what kind of insect it is,—that is, whether it is some state of moth, beetle, fly, &c., or other main division of insect-life; then, with the help of the descriptions of the chief forms of attack to whatever crop or tree we may wish to refer to, we shall have

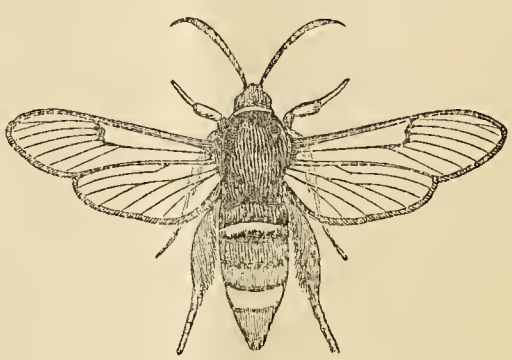
a very sound and serviceable amount of information which we can work on from if we choose, but of practical use as it stands.

With regard to the first point, that is whether the creature under examination is an insect, one difficulty in gaining a knowledge of insects arises from their passing their lives in three different conditions; 1st, that of the *larva*—that is the grub, maggot, or caterpillar; 2nd,



Goat Moth caterpillar (half-grown), and chrysalis.

the *pupa*, or chrysalis; 3rd, the *imago*, or perfect insect,

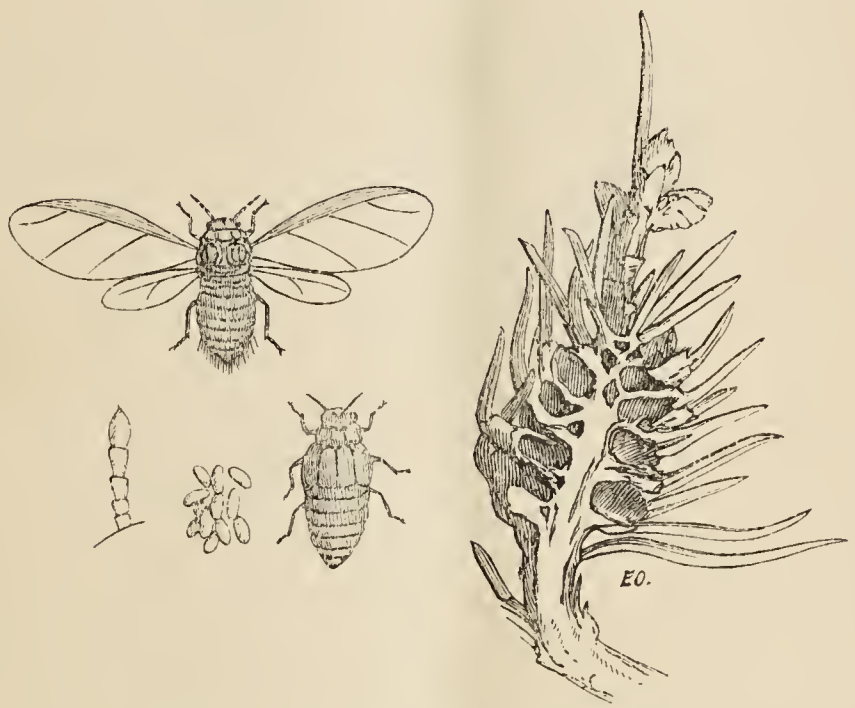


Hornet Clearwing.

in which they are often as distinct in appearance in one stage from the others as if they were different creatures.

In the perfect state they may usually be known by possessing a distinct head, thorax or trunk, and abdomen, the head being furnished with eyes, simple or compound, or both, jaws of very various form, and horn-like appendages on the front of the head, known as antennæ;

and the thorax is furnished with three pairs of legs, and usually with two pairs of wings, but sometimes these are absent. In the preceding stage, that of the pupa, in which development is taking place from the larval to the perfect stage, the insect is sometimes very similar in appearance to what it becomes in its perfect state, excepting that the wings and wing-cases are not fully developed. This is the case with Aphides, Crickets, and



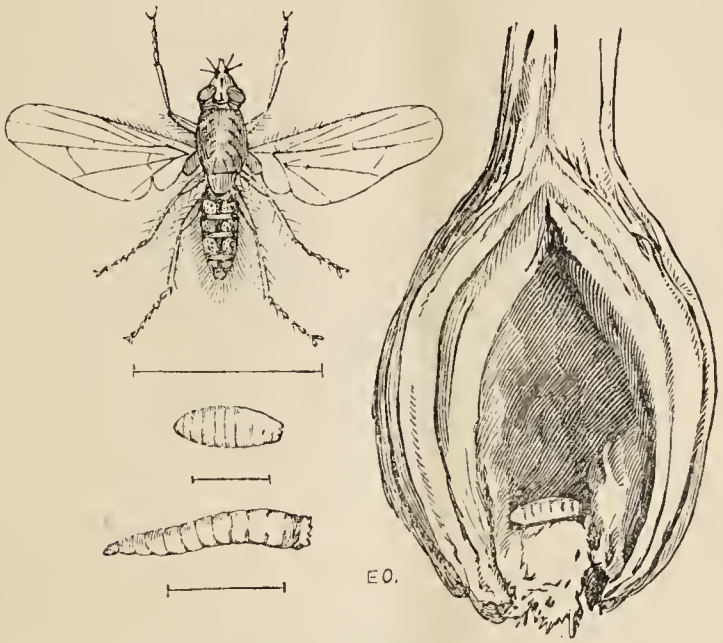
Spruce Gall Aphis (*Chermes abietis*).

Locusts, and some others, but with Moths and Butterflies the pupa is motionless with the forming limbs enclosed in the case, that we know well as the chrysalis. With beetles the limbs are folded down and visible,—that is, not hidden by a thick case of hardened gummy secretion, as with the Moths just mentioned,—but they have no power of locomotion; and this is also the case with the pupæ of the Wasps, Bees, Ants, Gallflies, Sawflies, and other very various insects forming the order of the *Hymenoptera*. With Two-winged Flies (*Diptera*) the pupa-case sometimes shows the shape of the coming limbs; sometimes, as with Onion Fly, is merely the hardened skin of the maggot, inside which the fly

is forming, and out of which it will presently split open its way.

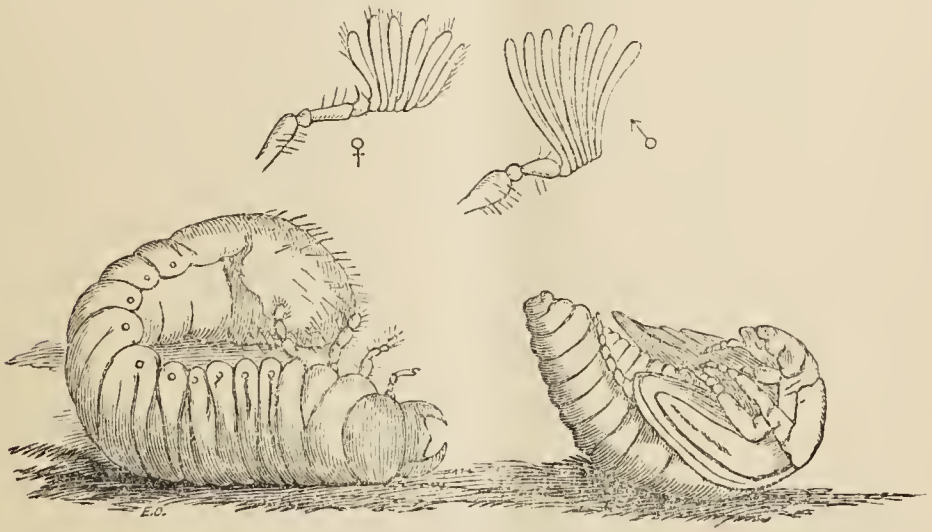
It is in the first stage of insect-life that the real difficulty occurs of knowing what we have under examination, and this is well worth the trouble of mastering. There are thirteen orders of insects. Of these we need not trouble ourselves about the Fleas (*Aphaniptera*), nor the Bee-parasites (*Strepsiptera*), which are parasitic in their larval state in Bees and Wasps; nor with the Caddice Flies (*Trichoptera*), of which the larvæ usually live in cases formed of morsels of sticks, or shells, or anything attainable in the water. Of the remaining ten orders, there are five in which the larval state very much resembles that of the perfect insect; it is regularly insect-shaped, with three pairs of legs, but is without wings. These five orders contain the Earwigs (*Euplexoptera*), the Crickets, Locusts, Cockroaches, &c. (*Orthoptera*), the Thrips (*Thysanoptera*), and the two orders formerly classed together, of which one contains the Aphides, the Scale insects, and Cicadas, &c. (*Homoptera*), and the other the Plant Bugs (*Hemiptera*). For the most part the larval or first stage of these insects is so like the pupal or second, and the complete state, that there is no difficulty in knowing them, an Earwig, an Aphis, or a Cricket differs little excepting in size and presence, or absence, of wings throughout its life. And so it is with many others, and this reduces the orders we need especially to consider to five. Of these four are very important. These are the orders which include the Two-winged Flies (*Diptera*), the Beetles (*Coleoptera*), the Moths and Butterflies (*Lepidoptera*), and the Sawflies, Gallflies, Wasps, Bees, and some others which, though not all similar in the larval state, are classed in the order *Hymenoptera*, from the wings of the insects in the perfect state being "membrane-like." The larvæ of these four orders are for the most part distinguishable by the presence, or the absence, or the number and nature of their feet considered together with the nature of the head and jaws.

The larvæ of the Two-winged Flies are commonly fleshy, cylindrical, and footless, the head often soft and fleshy, and capable of being withdrawn into the grub,



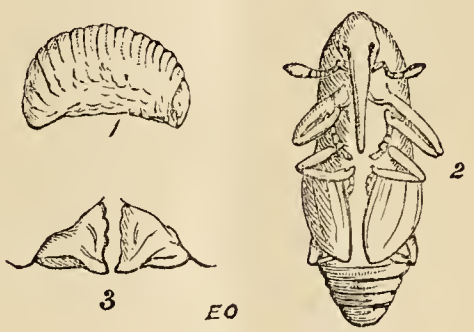
Onion Fly (*Anthomyia ceparum*).

and it is generally furnished with two horny hooks, capable of being protruded and retracted vertically, instead of regular jaws, with which the grub, as it were, reaps the tissues within the leaves, or whatever it may feed on, into itself. Very often these larvæ are pointed at the head and obtuse at the tail, which is furnished with differently shaped tubercles or processes.



Larva, pupa, and antennæ of Cockchafer (*Melolontha vulgaris*).

The larvæ of the Beetles are commonly short thick grubs, having scaly heads, furnished with jaws, and having frequently a pair of jointed feet or legs on each of the three segments next to the head, and a sucker-foot at the end of the tail. Sometimes, as with the larva of the Nut Weevil, or other kinds of Weevil, the

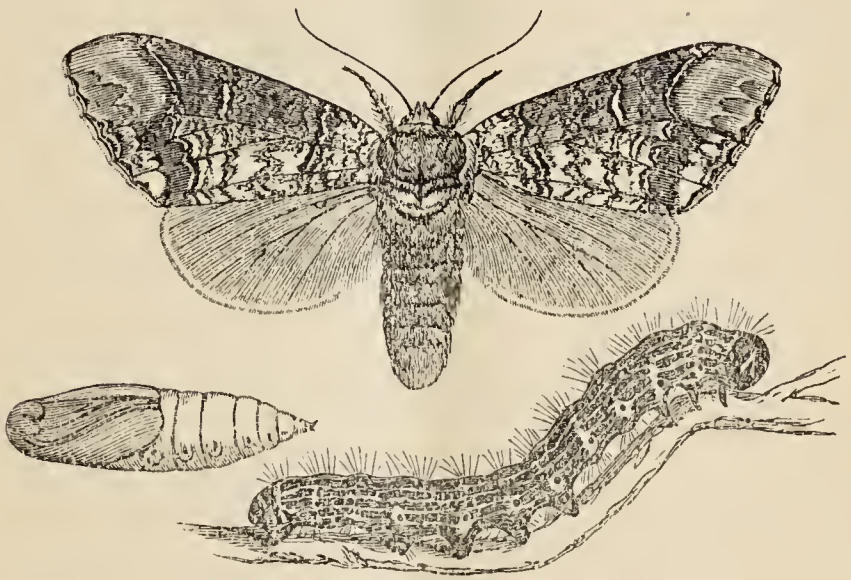


1, larva; 2, pupa of Granary Weevil (*Sitophilus granarius*).

three pairs of legs are absent, but the student will observe that, even if the larva is legless, it may be distinguished from the legless-fly larva by possessing a scaly head furnished with jaws. Chafer larvæ, Weevil larvæ in Turnip galls, and Wireworms are some of the commonest forms of Beetle-grubs.

The larvæ of Moths and Butterflies, commonly known as caterpillars, are generally recognised by their soft and cylindrical form, and their ornamental colours; like Beetles, they have a head furnished with jaws, and have almost invariably a pair of short feet on each of the three segments next to the head, and a sucker-foot formed of a pair of what are termed prolegs at the end of the tail. But also—and this is an important point in distinguishing *Lepidopterous* larvæ—the four middlemost of the intermediate segments are commonly furnished with a pair of the short fleshy legs used merely for holding by, and termed prolegs, or sucker-feet. These are not more than eight in number, sometimes fewer, and the caterpillar is generally thus arranged: 1st segment, the head; 2nd, 3rd, and 4th each bear a pair of articulated feet; 5th and 6th, without appendages;

7th, 8th, 9th, and 10th, each (except in the case of looper caterpillars, or a few others), furnished with a pair of prolegs; 11th and 12th, without appendages; 13th, with a caudal proleg, excepting in a few cases, as

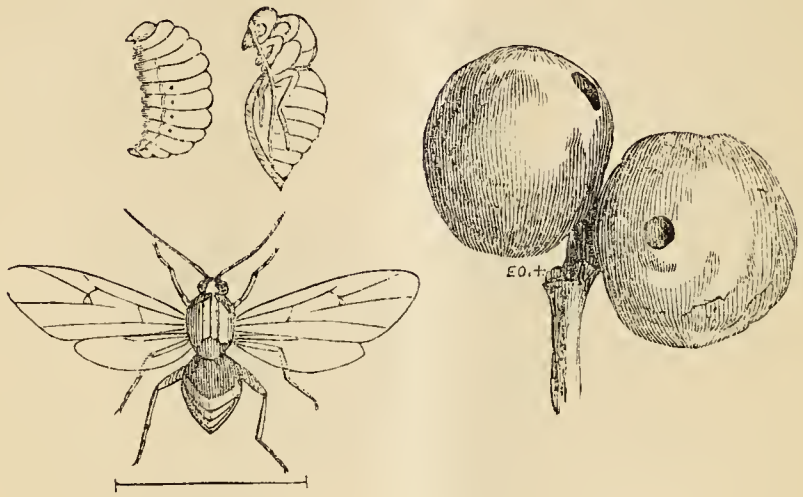


Buff-tip Moth (*Pygæra bucephala*).

with the singularly-shaped caterpillars of the Puss Moth, Lobster Moth, and some others. This order, it will be seen, is mainly distinguishable in the larval state by the ornamental colouring of the long cylindrical caterpillars, and by the number of the prolegs, from the preceding one of Beetles.

The next order is more complicated, for under the head of *Hymenoptera* many families are collected. The larvæ of almost all are worm or maggot-like and footless, and the mouth or jaws slightly developed. Of the nineteen families of which this order consists, we well know the maggots of the five containing the Ants, the solitary and social Wasps, and various kinds of Bees. Of the twelve other families resembling these in the larvæ or grubs being footless, with slightly developed mouths or jaws, the two we have most to do with are the Ichneumon flies, which feed within other insects (of these the

Ichneumon of the caterpillar of the Cabbage Butterfly is an example), and the Gall-flies or *Cynipidæ*, of which good



Marble Gall-fly (*Cynips Kollari*).

examples may be found still in the "Marble Galls," or, in spring, in the "King Charles" Gall of the Oak. These legless larvæ are distinguished with ease from the larvæ of Flies, or of Moths and Butterflies, but in many cases it is almost impossible to distinguish them from those of Beetles, and the student must either rear them through their second stages, or be guided by their locality, food, and habits, or, better still, take counsel to learn their nature with certainty. The two remaining families of the *Hymenoptera* are of great interest—one including the great Wood-boring Grubs of the *Sirex* (*Uroceridæ*), we know by the long cylindrical larvæ, with small heads furnished with square horny-toothed jaws, and having a pair of very minute feet on each of the segments next to the head, also by the terminal segment of the body being enlarged and terminating in a sharp point. I need only ask your special attention in these dry details to one more family, and this still of the *Hymenoptera;* it is that one equally ruinous at times to the farmer and the forester, that of the *Tenthredinidæ*, including the various kinds of Sawflies. The larvæ of these much resemble the Moth caterpillars, in being often gaily coloured, and have a head furnished with jaws and a pair of feet on

each of the three segments next to the head, and, excepting in the case of the Corn Sawfly caterpillar and one (possibly two) other kinds, which have no sucker-feet, they all have a caudal proleg, but they may be conveniently and easily known from other caterpillars by the number of pairs of sucker-feet beneath the body. Some of them have, besides the caudal proleg, five pairs of

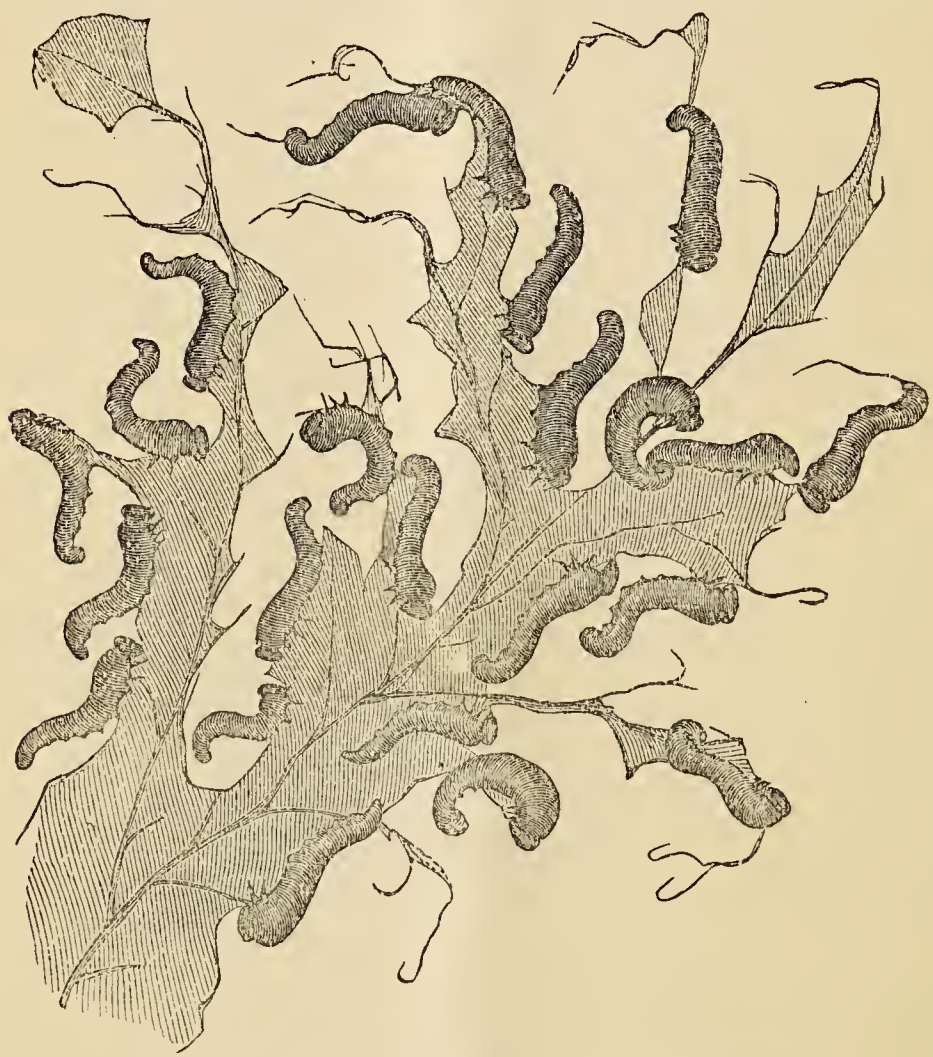
Pine Sawfly (*Lophyrus Pini*).

abdominal sucker-feet, some have six pairs, and some have seven pairs, whereas the Moth and Butterfly caterpillars have not more than four pairs of the abdominal sucket-feet.

Of the remaining order we do not need to take much notice for agricultural purposes. This includes, under the name of *Neuroptera*, the Dragon-flies, Stone-flies, and May-flies, which pass their first stages in water, and the *Termites*, or White Ants of tropical climates, also the Golden Eyes, which prey in the larval state on Aphides ; the larvæ are furnished with six articulated feet, but the distinctions are so difficult to follow up serviceably, and besides, few of the families are important to us agriculturally, that I therefore refer the student to the

descriptions in Professor Westwood's 'Introduction to Entomology' rather than enlarge further on this order now.

It is of great importance to us to be able to distinguish the injurious insects in their larval conditions, as it is in this stage that they commonly do us the most harm, and also from peculiarities in their constitution fall from time to time within our power. The larva usually eats voraciously and grows fast, but the skin does not stretch beyond a certain point, and, when this is reached, the tight-fitting covering splits, and the larva emerges in a new coat from its cast skin, and when this operation is



Sawfly caterpillars destroying Turnip-leaf.

about to happen, it is particularly susceptible of injury. In the case of the Turnip Sawfly, for instance, the cater-

pillar changes its skin every six or seven days ; but unless it has previously fixed itself firmly to the edge of a leaf or some substance by means of its sucker-feet, it cannot free itself from the old tight-fitting coat, and it perishes within. This is one reason why, in bad attacks of this pest, sometimes known as "Niggers" or "Black Palmers," any method of brushing the Turnip leaves has been found serviceable. Pine boughs fixed in front of a scuffler, beating the plants with a light bough held in the hand, or the use of a rope dragged by any means which will keep it a little above the ground, are all useful in this way, besides the obvious benefit to us of the numbers that are crushed, bruised, and otherwise prevented from getting back to their food-plant. The principle of shaking or beating injurious larvæ from bushes and fruit-trees might very desirably be carried out much further than it is at present in this country. Many kinds of caterpillars will fall at once on a smart shake, "jarring," as it is termed in American cultivation, and, as almost all larvæ have only a special range of food plants, if they are prevented crawling back by throwing anything they cannot cross round the stems, all that are not on the point of turning to *pupæ* must perish. A few of our injurious insects are general feeders, but the greater part of them are limited in their diet, or especially frequent certain orders of plants ; and this point is an important one for consideration, not only regarding rotation of crops, by which the maggots (or insects in any stage) which may have remained in the ground after any one kind of crop may be fairly starved out before it comes round again, but also with regard to destruction of weeds allied botanically to the cultivated plants. The Turnip Fly feeds also on wild plants of the Cabbage order, notably on Charlock, which, therefore, is a most undesirable weed ; the golden patch, where its yellow flowers show it has been left to thrive in careless neglect, shows a centre for fly which sometimes infects a whole district. The *Aphis granaria* of our Corn is to be found also on several of the common grasses which grow

in neglected spots, as the Wild Oat, the Soft Brome-grass, beside the Rough Cocksfoot, and others. Several of the insects injurious to the Hop also frequent the Nettle, which is nearly allied to it botanically, and the small Ermine Moth infests the Hawthorn with its webs full of caterpillars as well as the Apple.

Removal of weeds, or an unnecessary amount of useless plants which feed or attract the crop-insects, is desirable in itself, and it also acts well by diminishing the unnatural aggregation of special kinds of vegetation, which is one of the causes of the unnatural aggregation of insects injurious to us agriculturally. Where plants are scattered over the face of the country, the insect-feeders on them are necessarily fewer, and are subject to many more circumstances tending to diminish their numbers than where, as amongst growing crops, there is every appliance for their nurture, food, protection, and the support of suecessive broods on the same spot, or in the same neighbourhood, year after year. We cannot avoid this, but we can avoid allowing our fields, the edges of woodlands, or waste patches being full of the kinds of weeds or wild plants calculated to increase the evil. We have destroyed the natural balance by the amount we grow of food-crops, and, as might be expected, we have often an increase in the amount of the insect-feeders ; but as these depend on many circumstances, states of weather amongst others, for their full development, the amount of attack cannot always be calculated on, and we need to hold the remedies in our hands to apply as called for, or else we may suffer severely.

For this reason the indiscriminate encouragement of insectivorous birds is not so entirely desirable as it is sometimes thought. The flocks that appear when there are special attacks should by all means be protected, and their very presence taken as a sign that there is something underground needing attention. Such are flocks of Rooks tearing up the grass infested by grubs of various kinds, Sea Gulls following the plough, Titmice destroying Aphides, and other instances could be multiplied ; also a

certain amount of regular bird presence should be scrupulously kept up, including some of the twilight flyers, as the Nightjar, and others, which help us regarding injurious Moths ; but with regard to establishing colonies of birds, it may be doubted whether there are many so purely insectivorous or animal feeders as not to make it a great risk that if insect-food fails they will be infinitely worse for the crop. Also it is not always borne in mind that one great natural protection we have from injurious excess lies in the insect parasites, the Ichneumon, and other kinds of parasitic flies, and tbat the insectivorous bird will destroy alike our insect pest and our insect helper.

Weather influences do not act quite similarly on all kinds of insects, and these effects are very important, for, although we cannot as yet forecast weather reliably enough for agricultural purposes, we can very reliably forecast some kinds of insect-attack from certain states of the weather joined to their effects on plant-life and on the condition of the ground ; also we can modify weather effects by agricultural operations, amongst others by such drainage and arrangement of field ponds and cisterns as would enable us in some degree to store the surplus rainfall of one season to meet the deficiencies of the next. Some insects, such as the *Tipulæ*, commonly known as the Daddy Long-legs or Crane Fly, may surely be expected (unless proper measures are taken) in greater numbers after wet seasons ; the damp ground and protection of the damp leafage suit them best for oviposition and development ; their larvæ will bear continuous immersion in water for about fifty-eight hours without being destroyed, and it was found, in an experiment kindly tried for me by Mr. Whipple, at Kew Observatory, that they would exceptionally bear a temperature of ten degrees below zero, that is forty-two degrees of frost. There is a widespread idea that a severe winter is a great help to us by clearing off caterpillars, maggots, and insects generally, but, so far as observations go at present, this is very far from being

the case. Larvæ of various kinds and chrysalids of Cabbage Butterflies have been exposed to cold that froze them hard, but on thawing appeared perfectly uninjured; the chrysalids developed in due time, and, as I found in the following year a small patch in my garden infested by the Black Weevils (*Otiorhynchus sulcatus*), where I had never been troubled by them before, I conjectured that the experimental larvæ of this species also were as uninjured as they appeared! Instances have been recorded showing that insects will bear a much lower temperature than they are likely to be exposed to in this country, but nevertheless they feel it. A sharp frost early in autumn will have a good effect in clearing Saw-fly caterpillars from trees in Pine plantations, and some of the ground-living larvæ will go deep down in winter or during severe cold. Wireworms will go as much as a foot down, Cockchafer grubs will go down as much as two feet or more, and at these depths they rarely have to encounter a cold much below freezing-point. During the last winter, at my own climatological station at Isleworth (where the minimum thermometer on grass read as low as between two and nine degrees on several nights after the 20th of January), the temperature at one foot below the surface did not sink below 31 deg., and that at two feet not below 34 deg. This habit of some larvæ of burying themselves is important agriculturally, as it may be that in consequence, ploughing, or paring, or operations especially meant to clear an infested field, may pass harmlessly above the spots where they lie buried for awhile.

Generally speaking, sunshine and warmth appear to be the most favourable conditions for insect increase in this country during the months in which they are active. The parent insects are more lively and vigorous under such circumstances, and their longer flights in sunshine than in dull rainy weather spreads the attack over a larger extent of country, a larger proportion of the eggs appear to hatch, and the larvæ to thrive better on plants with their sap matured by sunshine than on the watery

flow following on excessive rainfall. Sudden rainfall after drought often destroys great numbers of caterpillars, sometimes by producing violent purging, but whether this is from the external moisture chilling the exposed larva, and clogging the breathing pores, or that the flow of watery sap disagrees with the larval constitution, is not clearly known. The dew of the evening, or a light rainfall, or mist, helps us also, so to say, mechanically, for at these times dressings will adhere to the insects which otherwise would fall off without being of service to us. For this reason the late evening or the early morning are the best times for such applications to many kinds of attacks, and a want of consideration of this is often the cause of the same kind of dressing failing, or succeeding, at different times quite unaccountably to the operator. This is especially the case with Turnip Fly—moisture clogs its leaping-legs, and, until it is dry again, the flea-like springs that put it out of reach of dressings, or shake off what may fall on it, are an impossibility.

There is often some one portion of the economy or habits of an insect by which it falls into our power, and, by looking to this point (which sometimes runs through many of one family), we may get rid of the visitation easily, surely, and without much outlay. We find that caterpillars of various kinds of Sawflies make their cocoons just below the surface of the ground; therefore removing the surface-soil beneath Gooseberry bushes, or beneath Pine trees, where the cocoons are usually formed (in masses near the trunk) is very serviceable. The attack of Corn Sawfly, which goes into pupa in the Corn stem at the ground level, may be prevented by collecting and burning the stubble. With regard to many larvæ that feed within the seeds, leaves, or stems, the simple plan of burning the infested plants, instead of throwing them to rubbish heaps, where the creatures can complete their development, or go down for the purpose into the earth beneath, would, in the most literal sense of the word, *prevent* much coming attack. Wheat Midge in

neglected chaff heaps, which it used to be a custom, when I knew West Gloucestershire, to leave anywhere in odd corners on the small farms; also Celery Fly in the leaves (an important attack in market gardens), are instances of attention being needed. Aphides are in many cases self-protected against washes by the fact of the smooth or lightly powdered nature of their coats repelling simple watery applications; therefore it is that anything adhesive, as soft-soap, makes such an excellent foundation for a wash, as is practically shown in our Hop ground by the soft-soap washes regularly used. In most of our insect attacks there is similarly some one point on which the practical observer can lay his hand for prevention or remedy, which will be shown him by short study of its habits, but I fear I have already detained you at such length that I ought not to add more now on this subject, particularly as I wish to urge the importance in insect prevention of those principles of good cultivation, applicable alike to field, or orchard, or forest growths, which you, gentlemen, students of this College, with its world-wide reputation, are especially qualified to carry from it for our national benefit.

It cannot be too strongly brought forward that in such means as will carry on a steady healthy growth lies much of the safety of the agriculturist, from severe loss by the commonly recurring pests of his fields. I do not say from all, for there are occasional visitations which cannot be foreseen, and also, although we may be careful, we cannot help our neighbours inflicting the consequences of their carelessness on us. One important means towards this is a good start. If the plant is checked in germination the chances are that plant never recovers it entirely as long as it lives, and will go down before insect attack much sooner than the others. The points to secure this it is not for me to enter on here, but I may just allude to the importance of good seed, and a good seed-bed; such tilth as will throw no impediments in the upward or downward course of the sprouting plant, and also (speaking more especially of the Turnip

crop) of such treatment as may in seasons of drought preserve the moisture that is in the soil, or is artifically brought there by farm manure, or again, the excellent effects that have been found to result in some instances from putting in seed with the water-drill. There is thus a supply of moisture ready to aid germination and first growth. The young plant may very likely be just as much gnawed by the "Fly" as the others, but the much greater rapidity of growth carries it well on, so that three or four holes gnawed in the leafage, that would be utter ruin to a young plant struggling out of a dry soil, are of little consequence to the plant of vigorous growth, and the losses of resowing are saved. Even taking the water-cart over the field (where a water supply was attainable) has been found to bring up a lagging crop. With regard to precise effect of watering on the germinating plant, I can state, from such experiment as I have been able to make, that at the end of a fortnight from their appearance above ground, the plants from a patch of Turnips which had been watered (in a season of drought) on either two or three evenings, weighed one quarter or rather more than the plants from precisely the same measure of ground close by, and in exactly the same circumstances, excepting that they had not been watered. In case of fly-attack a quarter more of growth would often save the crop.

The same principle of pushing on vigorous growth by all measures of good cultivation holds good with regard to attacks on more advanced leafage, as of the leaf-miners in the Celery or Beet, or the weevils whose presence we know of by the semi-circular scoops taken out of the Bean or Pea leaves. Say the maggot or beetle destroys a couple of inches of the leafage in a day, if the plant growth is only an inch and a half, it necessarily fails, but let the soil it is in, or extra dressings applied, be such as to push on a little more than the two inches, and it keeps its ground, or, as it is well said, "grows past."

Many of our crop-pests are only in their feeding stage

for a few weeks, and if we can support the plants through this all will be well, for, in the case of a second brood, the crop will by that time be too much advanced to be readily devastated. But even with those two great scourges, the Wireworm and the grub of the Daddy Longlegs, the same principle holds good, and is indeed very often all we can fall back on for trustworthy remedy, if these larvæ have been allowed to establish themselves in the ground. Both of these most destructive grubs are in the habit of partly eating through the root or the stem close to the root of the plant they attack,—they do not always sever it,—consequently, though it is by no means in all cases killed, yet a large portion of its power of drawing up food is cut through, and the plant suffers in this proportion. In such circumstances. if a dressing of some stimnlating manure which will dissolve down to the roots with the first rain-storm, is given (such as guano, for instance), it will act at once on the plant growth, and be highly beneficial. We had instances of this well worked out in the bad attacks of *Tipulæ* larvæ last year.

I have now endeavoured, although by no means with the force or clearness that the importance of the subject calls for, to lay before you some points for your consideration. What we need is such a knowledge of the main divisions and habits of insect-life as will help us to know in case of attack what it is that is injuring us, and also what general principles of insect and of plant-life jointly to work on. The knowledge of the life-history of our common injurious insects is needed by all who grow the crops that are food-plants to these destroyers as well as to ourselves, for thus, in some cases, we are warned betimes, and in others we know (however threatening it may look) that the attack is only a passing evil which extra food will carry the temporarily weakened plants over. There is no difficulty in this,—probably each one in this room has such a practical acquaintance with the workings in the crops of the regular crop-feeders as would enable him to follow up the subject for himself by

the name of the crop from the indexes of books in the library of this College.

The great mistake is taking the subject by the wrong end; starting by trying to name the insects we meet with instead of being content at first to work back to their name from observations of their habits and method of injury to the crops. We cannot name insects *generally* (that is, the isolated specimens we chance to meet with) with certainty. If we consider that in the collection of the great British entomologist, J. Francis Stephens, he possessed more than three thousand species of British Beetles, more than two thousand Two-winged Flies, and nearly that number of species of Moths and Butterflies, and other orders in corresponding proportions, we shall see that it is a perfect impossibility for any one who is not able to devote his whole time to the subject to have a special knowledge of more than a small part of the orders. But the life-histories of about one hundred insects we can easily manage, and the importance of the subject will well repay the labour of what is rather putting in form knowledge already possessed than a new study. The subject is one of great importance,—a yearly drain on our individual and national resources; and you, gentlemen, who go from this College to lay the foundation of thoroughly working principles of agriculture in this country and our colonies, are those who best can aid us in the future.

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